The Value of Control and the Costs of Illiquidity

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October 2012
Agenda and motivation

- Valuation of controlling blocks.
- When a controlling block holder and dispersed shareholders coexist then:
  - Trade-off between **private** benefits (tunneling, perqs) and costs (effort, marketability) of control
  - Trade-off between **shared** benefits (incentive alignment, monitoring management) and costs ("illiquidity spillovers") of control
- This paper is an attempt at estimating:
  - **marketability discount** of controlling stakes and **illiquidity discount**, accounting for private benefits and shared benefits
  - identify the determinants of illiquidity in the market
- Why? Ownership *is* concentrated (Holderness 09, Dlugosz et al. 06).
Approach to estimating marketability discount

1 Challenge:
   1. illiquidity introduces potential non-linearities in pricing
   2. illiquidity constrains the empirical strategy
   3. estimating discounts requires knowledge of unobservables

2 Develop an estimable search-and-bargaining model of majority block trades
   1. Identification of liquidity shocks intensity
   2. Identification of fire sale value

3 Data set: controlling block trades with share values from blockholder and dispersed shareholders

4 Structural estimation $\Rightarrow$ counterfactual analysis
Value of control: Masulis et al 09, Kalay et al 11, Albuquerque and Schroth 10

Search models of OTC markets: Duffie et al 05, 07, Feldhutter 10

Legal practice: Mandelbaum v. IRS (US Tax Court Case 1995-255):
  - **30% marketability discount** applied to shares of Big M
  - value based on prices of restricted and nrestricted shares: size of block?; control changes?

Concentrated ownership and illiquidity: Demsetz 68, Holmstrom and Tirole 93, Bolton and von Thadden 98, Maug 98

Illiquidity spillover: Vayanos and Wang 07, Weill 08, Amihud et al 97, Chordia et al 05, Aragon and Strahan 09

Illiquidity on non-controlling stakes: Amihud and Mandelson 86, Pástor and Stambaugh 03, Acharya and Pedersen 05
Scatter plot of block premium and returns

Cumulative abnormal returns: \((p^{1} - p^{0})/p^{0}\)

N = 17

N = 49

N = 36

N = 49

Block premium: \((P - p^{0})/p^{0}\)
Share price path

Event time (trading days)

Market-Liquidity Adjusted Price | CAR<0
Market-Liquidity Adjusted Price | CAR>0
Model: elements

- Discrete time, infinite horizon, with discount factor, $\delta$.
- Incumbent, controlling shareholder, $I$
  - owns $\alpha > 0.5$, $1 - \alpha$ is dispersed
  - current cash flow, $\pi_I$
  - private benefits $B$
  - block value $v(\pi_i)$, share price $p(\pi_i)$
  - $I$’s Nash bargaining power is $\psi$

- Search frictions: every period:
  - with probability $\eta$, a rival $R$, arrives with current cash flow $\pi_R \sim F(\pi)$
  - $I$ gets a liquidity shock with probability $\theta$
  - upon liquidity shock get fire sale price, $\phi v(\pi_R)$
The block holder’s problem

- No liq shock, 1-θ
- Incumbent cash flow, π₁
- Liq shock, θ

Rival drawn, πᵣ

Gains from trade, πᵣ > π₁
- Rival takes over after bargaining

No gains from trade, πᵣ < π₁
- Incumbent holds on to the block

Rival drawn, block sold at fire sale price φv(πᵣ)
The current per share value of the block satisfies

\[ v(\pi_I) = \pi_I + \delta \left[ (1 - \theta) \bar{v}(\pi_I) + \theta L_v \right], \]

where

\[ \bar{v}(\pi_I) + B = \eta \int_{\pi_R} \max \left\{ \begin{array}{c} b(\pi_I, \pi_R), v(\pi_I) + B \end{array} \right\} dF(\pi_R) \]

\[ + (1 - \eta) (v(\pi_I) + B) \]

\[ L_v = \phi \int_{\pi_R} v(\pi_R) dF(\pi_R), \]

\[ \Rightarrow \text{Blockholders exchange the option to sell in the future.} \]
Absent a liquidity shock, the block price results from Nash bargaining:

\[ b(\pi_I, \pi_R) = \begin{cases} 
0 & \text{if } \pi_R \leq \pi_I \\
\nu(\pi_I) + B + \psi [\nu(\pi_R) - \nu(\pi_I)] & \text{if } \pi_R > \pi_I
\end{cases} \]

Trading rule only depends on cash flow values, \( \pi \)

Value of option to sell depends on \( I \)'s bargaining power, \( \psi \)

\[ \tilde{\nu}(\pi_I) + B = \nu(\pi_I) + B + \psi \eta \int_{\pi_R} \max \{ \nu(\pi_R) - \nu(\pi_I), 0 \} \, dF(\pi_R) \]
Dispersed shareholders’ value

- The current stock price must satisfy

\[ p(\pi_I) = \pi_I + \delta [(1 - \theta) \tilde{p}(\pi_I) + \theta L_p], \]

where

\[
\tilde{p}(\pi_I) = p(\pi_I) + \eta \int_{\pi_R} \max \left\{ p(\pi_R) - p(\pi_I), 0 \right\} dF(\pi_R),
\]

\[ L_p = \int_{\pi_R} p(\pi_R) dF(\pi_R). \]

- They inherit the block holder’s option to sell
- Dispersed shareholders take as given (efficient) trading rule
- Their value does not depend on bargaining power \( \psi \)
Prices

- The observed block premium is

\[ BP(\pi_I, \pi_R) = \begin{cases} 
\frac{\phi_v(\pi_R)}{p(\pi_I)} - 1 & \text{if liquidity shock,} \\
\frac{b(\pi_I, \pi_R)}{p(\pi_I)} - 1 & \text{if no liquidity shock.}
\end{cases} \]

- The observed cumulative returns are

\[ CAR(\pi_R, \pi_I) \equiv \frac{p(\pi_R)}{p(\pi_I)} - 1. \]

- The econometrician’s problem:
  - to recover the model’s parameters knowing \( BP \) and \( CAR \)
\[ p(\pi) \] and \( CAR \) are independent of \( \phi \), but \( BP \) isn’t,

- **conditional** on a liquidity shock, the variation in \( BP \) that is orthogonal to the variation in \( CAR \) is due to \( \phi \).
φ: $p(\pi)$ and CAR are independent of φ, but BP isn’t,

- *conditional* on a liquidity shock, the variation in BP that is orthogonal to the variation in CAR is due to φ.

θ:

- CAR $< 0$ signals liquidity shock
- *absent* a liquidity shock, $BP / \psi - CAR$ is approximately equal to

$$\frac{v(\pi_R, \theta)}{v(\pi_I, \theta)} - \frac{p(\pi_R, \theta)}{p(\pi_I, \theta)} > 0,$$

which is strictly decreasing in θ.
US disclosed-value acquisitions in Thomson One Banker 1990-2010:
- block size is between 35% and 90%,
- Exclude recapitalizations, repurchases, carve-outs, bankruptcies,
- must be matched to CRSP daily prices between \( t - 51 \) and \( t + 20 \) trading days,
- must be matched to COMPUSTAT’s last December’s observation.

⇒ 114 deals

Other data:
- GDP growth, Fontaine-Garcia liquidity, market returns, returns vol and slope of yield curve
- M&A volume in industry of target, block size, leverage and others
Empirical specification

- We derive the theoretical $BP_i$ and $CAR_i$ from a more general version: time-varying $\pi' \sim F(\pi'|\pi)$.
- For deal $i = \{1, 2, ..., N\}$, we parameterize $\phi_i$ and $\theta_i$ as

$$\theta(z_i, \beta) = \frac{\exp(z_i'\beta)}{1 + \exp(z_i'\beta)},$$
$$\phi(x_i, \gamma) = \frac{\exp(x_i'\gamma)}{1 + \exp(x_i'\gamma)}.$$ 

- Choose $\beta, \gamma, \eta, \psi, B$ to match the moments of the simulated joint distribution of $BP$ and $CAR$ to the data, minimizing

$$[m(BP, CAR, z, x; \beta, \gamma, \eta, \psi, B) - M] \times W \times [m(\cdot) - M].$$
Moment conditions

- **First order moments**

  \[ E(BP \times z), E(CAR \times z), E(BP \times x), E(CAR \times x); \]

- **Second order moments**

  \[ E(BP^2), E(CAR^2), E(BP \times CAR); \]

- **Conditional moments**

  \[ E((BP/\psi - CAR) \times x \mid CAR > 0), E((BP/\psi - CAR)^2 \mid CAR > 0), \]
  \[ E(BP \times z \mid CAR < 0), E(BP^2 \mid CAR < 0); \]

- **Third order moments**

  \[ E(BP^3), (CAR^3). \]
## Parameter estimates: full specification

### (1)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Estimate</th>
<th>Std. Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\eta$</td>
<td>1.000</td>
<td>0.952</td>
</tr>
<tr>
<td>$B$</td>
<td>0.119***</td>
<td>0.005</td>
</tr>
<tr>
<td>$\psi$</td>
<td>0.540</td>
<td>0.529</td>
</tr>
</tbody>
</table>

### Determinants of $\theta$

<table>
<thead>
<tr>
<th>Determinant</th>
<th>$\Delta \theta / \Delta x$</th>
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<tbody>
<tr>
<td>GDP growth</td>
<td>0.021 (0.013)</td>
</tr>
<tr>
<td>Market return</td>
<td>0.325*** (0.019)</td>
</tr>
<tr>
<td>Market volatility</td>
<td>0.290** (0.128)</td>
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<tr>
<td>Fontaine-Garcia</td>
<td>0.023** (0.009)</td>
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<tr>
<td>Yield curve slope</td>
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### Determinants of $\phi$

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<td>Block-to-industry size</td>
<td>$-0.003$ (0.017)</td>
</tr>
<tr>
<td>Industry’s M&amp;A volume</td>
<td>$0.011**$ (0.005)</td>
</tr>
<tr>
<td>Target minus industry leverage</td>
<td>$-0.264$ (0.206)</td>
</tr>
<tr>
<td>Industry specificity</td>
<td>$-0.017$ (0.013)</td>
</tr>
<tr>
<td>Industry market-to-book</td>
<td>$-0.124***$ (0.015)</td>
</tr>
<tr>
<td>Target volatility</td>
<td>$-0.121***$ (0.008)</td>
</tr>
</tbody>
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### Parameter estimates: full specification

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<td>0.111*** (0.007)</td>
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<td>$\psi$</td>
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### Determinants of $\phi$

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<td>-0.121*** (0.008)</td>
<td>0.058*** (0.011)</td>
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Estimated $\theta$ and $\phi$

![Histograms showing estimated values for $\theta$ and $\phi$ with quantiles and basic statistics.]
**In-sample predictions**

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<td>Mean</td>
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<td>Median</td>
<td>Mean</td>
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<tr>
<td>θ</td>
<td>0.374</td>
<td>0.32</td>
<td>0.267</td>
<td>0.342</td>
</tr>
<tr>
<td>φ</td>
<td>0.631</td>
<td>0.41</td>
<td>0.891</td>
<td>0.644</td>
</tr>
</tbody>
</table>

**BP**

- Actual
  - 0.068
  - 0.588
  - 0.035
- Predicted
  - 0.013
  - 0.552
  - 0.122

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<td>0.068</td>
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<tr>
<td>BP Predicted</td>
<td>0.013</td>
<td>0.552</td>
<td>0.122</td>
<td>0.058</td>
</tr>
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**CAR**

- Actual
  - 0.096
  - 0.319
  - 0.050
- Predicted
  - 0.002
  - 0.016
  - 0.000

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Using the model

Having estimated the model’s parameters, we compute:

- The *marketability discount* is

\[ d^M = 1 - \frac{v(\theta, \phi, \eta, .)}{v(0, \phi, 1, .)} \]

- The *illiquidity-spillover discount* is

\[ d^{IS} = 1 - \frac{p(\theta, \eta, .)}{p(0, 1, .)} \]
The marketability discount function

\[ 1 - \frac{v(\theta, \phi_i, \eta)}{v(0, \phi_i, 1)} \]

\[ \phi > \phi_{Q3} \]
\[ \phi \in [\phi_{Q1}, \phi_{Q3}] \]
\[ \phi < \phi_{Q1} \]

\[ \phi_{Q1} = 0.01 \]
\[ \phi_{Q2} = 0.12 \]
\[ \phi_{Q3} = 0.61 \]

Mean = 0.30
StdD = 0.32

\[ Q1 = 0.01 \]
\[ Q2 = 0.12 \]
Mean = 0.30
StdD = 0.32
\[ Q3 = 0.61 \]
The illiquidity-spillover discount function

\[ 1 - p(\theta, \phi_i, \eta) / p(0, \phi_i, 1) \]

\[ \pi > \pi_{Q3} \]
\[ \pi \in [\pi_{Q1}, \pi_{Q3}] \]
\[ \pi < \pi_{Q1} \]

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\[ \pi < \pi_{Q1} \]

\[ \pi \in [\pi_{Q1}, \pi_{Q3}] \]

\[ \pi < \pi_{Q1} \]

\[ Q_1 = 0.00 \]
\[ Q_2 = 0.01 \]
\[ Q_3 = 0.01 \]

\[ \text{Mean} = 0.01 \]
\[ \text{StdD} = 0.01 \]
Interpreting discount estimates

Direction of potential biases from structural estimation of $\theta$ and $\phi$:

- Suppose $\theta$ is a pure liquidity shock. Then $\phi$ is not a pure fire sale price
  $\Rightarrow$ model overestimates $\phi$

- Suppose $\phi$ is a pure fire sale price. Then $\theta$ is not a pure liquidity shock
  $\Rightarrow$ model underestimates $\theta$

- Discounts increase with $\theta$ and decrease with $\phi$
  $\Rightarrow$ discounts are underestimated.
## Linear effects

<table>
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<tr>
<th>Determinant</th>
<th>Squared partial corr</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target minus industry leverage</td>
<td>0.31</td>
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<td>0.00</td>
</tr>
<tr>
<td>Yield curve slope</td>
<td>0.08</td>
<td>0.01</td>
</tr>
<tr>
<td>Block-to-ind size</td>
<td>0.07</td>
<td>0.01</td>
</tr>
</tbody>
</table>
In the Mandelbaum case, Big M had:

- Much lower leverage than the median leverage in the industry
- Lower industry asset specificity
- Slope of yield curve was lower than average
  \[ \Rightarrow \text{Marketability discount predicted by model is about 7\% \ll 30\%} \]
Summary

- Adds to literatures on value of control and pricing of illiquid assets
- We propose a search-and-bargaining model to study the size and determinants of:
  - prob of liquidity shocks
  - fire sale price
- Structural estimation identifies them using variation in
  - proxies for aggregate liquidity,
  - target firm and industry characteristics linked to redeployability
- We find sizable
  - marketability discount with median 12%, and illiquidity-spillover discount with median 60 bp